through which the sun's heat is conveyed to and from the earth, the lower and denser strata absorb the greatest amount, and are necessarily the warmer;" a sentence of which a teacher would score almost every word. Again, on the subject of dew, we read that "substances like glass, &c., which *rapidly* lose their own heat and *slowly* acquire that of others are susceptible of being copiously bedewed." The italics are ours. And once more, "when the temperature of the air is reduced below that of the invisible vapour it contains, the moisture becomes visible." These extracts could be multiplied till we might wonder if it is really a book on *Physical* Geography we are reading. But these are serious defects, and we wish they could be altered. By the side of them it is of less consequence that while we read in the Preface that "this revision embraces all that is important in recent discovery;" yet on turning to the temperature of the sea, where the most important changes have taken place in our knowledge, we are still referred to Sir James Clarke Ross, and told that the ocean has below the surface a uniform temperature of $39\frac{1}{2}°$, for which at the equator we must descend deeper than anywhere else. We can scarcely imagine that any amount of clearness will atone for these things; let us hope they will be seen to before edition the ninth is required.

The Flora of South Australia. By R. Schomburgk, Ph.D., Director of the Botanic Gardens, Adelaide. (W. C. Cox, 1875.)

WE have here a complete list of the indigenous flora of South Australia, both tropical and extra-tropical, with some general remarks prefixed. The most predominant natural orders in the colony are Leguminosæ, Myrtaceæ, Compositæ, Proteaceæ, Cruciferæ, Rubiaceæ, and Gramineæ. The genera and species are remarkably circumscribed in area; many are found in one spot alone. The colony is singularly devoid of native edible fruits and roots; on the other hand it produces abundance of valuable timber-trees and of plants suitable for the manufacture of paper and other fibres, and for the production of dyes; but most of the valuable crops are naturalised plants, introduced from Europe or other parts of the world. A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Theory of Electrical Induction

IN NATURE, vol. xiii. pp. 437, 475, Prof. Paul Volpicelli gives an exposition of the two theories of electric induction, containing copious references to the writings of electricians, and numerous experiments of his own. It is remarkable, however, that he has not only omitted all reference to the works of Poisson, Green, Thomson, Beer, Betti, &c., who have studied the mathematical theory of induction, but he has not even introduced the word potential into his exposition, unless we are to take the word tension in the sense of potential, where he says that a certain portion of electricity possesses tension while another portion does not.

The result of this mode of treating the subject without calling in the aid of those ideas and phrases which the progress of science has developed, is to convey the impression that the whole theory of induction of electrification on the surface of conductors is still in a very imperfect and vague condition, whereas there is no part of electrical science in which we can trace more distinctly the correspondence, quantitative as well as qualitative, of the phenomena with the general laws of electricity. It appears, however, from what M. Volpicelli says, that an erroneous theory is still generally adopted in treatises on physics and electricity, and that it ought to be superseded by a more correct theory first proposed by Melloni.

Both theories admit that if an insulated conductor, without charge, is acted on by a charged inductor, the surface becomes electrified, oppositely to the charge of the inductor on the parts nearest the inductor, and similarly to the charge of the inductor on the parts farthest from it. The first of the two theories, however, asserts that both these electricities are "endowed with tension," whereas the second, that of Melloni, asserts that the electricity of the same kind with that of the inductor is alone "endowed with tension," while the other kind of electricity is entirely "latent or dissimulated."

The only sense which we can attach to the word "tension" as thus used, is that which modern writers mean by "potential," or potential function, the difference being that the word tension is often used in a vague manner, whereas potential is strictly defined.

Thus a point in space is said to have a certain electric potential, and since all points of a conductor in electrical equilibrium have the same potential, we speak of the potential of the conductor. But we do not speak of the potential of a charge of electricity, or of electricity being endowed or not endowed with potential. Such language would only lead us into error.

Let us suppose the inductor to be charged positively and the induced body to be insulated and originally without charge. Then, since its insulation prevents any electric communication with other bodies, its total electrification must remain zero, or there must be as much positive electrification as there is negative.

Hence for every line of electric force which proceeds from the inductor and falls on the induced body, there is another which proceeds from the induced body and falls on the walls of the room, or on some other body whose potential is zero. The potential of the induced body must therefore be intermediate between that of the inductor and that of the walls of the room, which is generally taken as zero. The potential of the induced body is therefore positive.

There is thus on the surface of the induced body a region nearer the inductor which is negatively electrified, and a region further from the inductor which is positively electrified. These regions are divided by a neutral line on the surface, which is the section of the surface by an equipotential surface in space which has the same potential as the induced body. The total charges on these two regions are exactly equal but of opposite signs.

If a small insulated conductor is placed in contact with any part of the surface and removed, it will be found to be electrified in the same way as the part of the surface with which it was in contact. A fine short needle point, or a burning pastille, placed on any part of the surface will dissipate the kind of electricity which exists on that part of the surface. See Riess, "Reibungs Elektricität," Art. 247.

If any part of the induced body is placed in electrical connection with the earth by touching it with a fine wire, positive electricity will be discharged, and the potential of the induced body will be reduced to zero. This will be the case whether the part touched be positively or negatively electrified. The quantity of electricity discharged will be the product of the potential of the induced body into its electric capacity.

After this discharge every part of the surface of the induced body will be negatively electrified, but the parts nearer the inductor more than those which are further from it.

In the mathematical treatment of the subject Thomson has found it convenient to divide the electrification into two parts, each distributed over the induced body according to its own law.

(α) The induced electrification when the induced body is connected to earth, and the charge of the inductor is E. This electrification is negative on every part of the surface, but the density is greatest next the inductor.

(β) The electrification when the induced body has a potential P, and the inductor, still in the same place, has no charge. This electrification is positive on every part of the surface.

From a knowledge of these two distributions it is easy to determine a third, in which the total electrification is the algebraical sum of (α) and (β), and in which the value of P is such that the total electrification is zero.

We might then assert that the electrification (β) is free, because it will be discharged if the body is connected to earth, but that the electrification (α) is latent or dissimulated, because it will not be discharged to earth.

The only danger of this mode of exposition is that it may suggest to a beginner the notion that electricity, like water and other substances, may exist in different physical states, in some of which it is more mobile than in others.

This idea of variation of quality once introduced into the

mind will tend to prevent the student from forming any clear and distinct conception of the phenomena.

Let us now examine how far M. Volpicelli's experimental skill and extensive reading have enabled him to give an accurate account of the phenomena, and how far he may have fallen into error from not availing himself of the idea of electric potential, but continuing to employ that of latent electricity.

Melloni, in his exposition, has represented the homonymous electrification (β) as greater on the side of the induced body further from the inductor. The fact, however, is that the electrification is distributed in the same way as it would be if the inductor were in its actual position and insulated, but without charge. It will therefore be densest on the projecting parts of the induced body; but if the two extremities of this body are geometrically similar, and if the inductor is made of a conducting substance, it will be somewhat denser on the extremity (B) next the inductor, because the surface of the inductor itself (C) will become electrified, and the electricity on the side next to B will be negative.

But the inequality of the distribution of the negative electrification (α) is so much greater that it completely masks that of (β), so that from an experimental point of view we must regard this error of Melloni as a very trifling one.

The next point we must notice is the mode in which objection (3) is expressed. It is as follows:—

"(3) Because of the two kinds of electricity which coexist upon the induced insulated body, only the homonym of the inductor is dissipated *by contact with the air*." (The italics are our own.)

We have no evidence whatever that electricity is ever dissipated by contact with air, whether dry or moist, unless the electric density is so great that a disruptive discharge takes place in the forms of "glow," "brush," or "spark," from sharp points connected with the electrified body.

If the electrified body and the surrounding conductors have rounded surfaces, and if the potential is moderate, it appears from the experiments of Boltzmann[1] that no measureable quantity of electricity passes through air or other gases, even when greatly rarefied, and when the experiment is continued for fourteen hours.

I have myself been unable to detect any conduction through a stratum of still air of two millimetres thickness, even when the temperature was raised to a red heat, and when steam, or the vapour of mercury or of sodium was introduced between the oppositely electrified surfaces. If, however, smoky air was introduced, there was a considerable effect arising from convection by the solid particles.

The cause of the powerful electrical effects of the stream of heated matter rising from a Bunsen's burner or from a red-hot ball, as in Guthrie's experiments, requires a special investigation.

The dissipation of the charge of insulated bodies which we actually observe seems to depend principally on the insulating supports on which they are placed, and if these are of good glass the conduction is almost entirely due to moisture on the surface of the glass. If the air which is in contact with the glass insulator is perfectly dry the dissipation of electricity will be extremely small, even when the air in contact with the electrified body itself is loaded with moisture.

It is not, therefore, by contact with the air that the electricity escapes, but by conduction to the earth along the so-called insulating supports, and the effect of this conduction is of course to reduce the potential to zero by discharging electricity of the same kind with that of the inductor.

We come next to the fourth of the five facts mentioned under the head of the First Experiment. It is stated as follows:—

"4. Points applied to the extremity of the cylinder nearest to the inductor allow only the homonym of the inductor to escape, and not at all the opposite electricity."

This will be the case if the point is electrically connected with the earth, and made to approach any part of the surface of the cylinder; but if, as the words seem rather to imply, the point is attached to the cylinder and projects into the air, then the statement is exactly opposite to that given by Riess in Art. 247 of his book, who correctly tells us that if the cylinder has a sharp point at one end, then if the point is turned towards the inductor, the cylinder becomes charged similarly to the inductor, whereas if the point is turned away from the inductor, the cylinder becomes charged oppositely to the inductor, the discharge from the point being always of that kind of electricity which exists on the part of the cylinder where the point is placed.

[1] Sitzb. der k. Akad. (Wien), April 23, 1874.

The fifth fact stated to be established by the experiment is—

"5. Induced electricity of the first kind (opposite to that of the inductor) is not transferred from the induced body to the inductor, but the electricity of the inductor may certainly be transferred to the induced body."

For the sake of distinctness, let us say that the inductor is positive, then it is here asserted that negative electricity does not pass from the cylinder to the inductor, but that positive electricity passes from the inductor to the cylinder.

If M. Volpicelli can give us an experimental method of distinguishing between the passage of negative electricity from *B* to *A*, and the passage of positive electricity from *A* to *B*, we may expect to learn more of the nature of electricity than any of our physicists have hitherto even hoped for.

J. CLERK MAXWELL

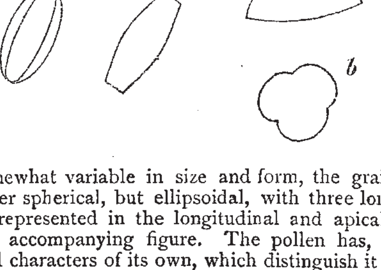
Cherry Blossoms

IN the last number of NATURE (vol. xiv., p. 10), Mr. Pryor states that the flowers of the wild cherry are bitten off in large numbers in much the same manner as I formerly described in the case of the primrose. Some days ago I observed many cherry blossoms in this state, and to-day I saw some actually falling. I approached stealthily so as to discover what bird was at work, and behold it was a squirrel. There could be no doubt about it for the squirrel was low in the tree and actually had a blossom between its teeth. It is none the less true that birds likewise bite the flowers of the cherry tree.

Down, Beckenham, May 6 CHARLES DARWIN

The Pollen of the Cherry

THE practice of the indefinite reproduction of woodcuts by means of *clichés* has frequently given rise to the repetition of erroneous drawings in one scientific text-book after another. Botanical text-books seem to have suffered especially in this way, in consequence of the great dearth of new and original illustrations by which they are characterised. Many botanical students must have been puzzled by the peculiar appearance presented by the pollen of the cherry in a very familiar drawing. It is hardly sufficiently explained that "the escape of the fovilla in an irregular jet," as there represented, has nothing to do with the process of fertilisation, but is an altogether abnormal phenomenon depending on the bursting of the pollen-grain from artificial moistening. The shape of the pollen-grain, as drawn, for example, in Balfour's "Class-book of Botany," Le Maout and Decaisne's "General System of Botany," and Dr. Hooker's Science Primer "Botany"[1] is also incorrectly indicated. The perfectly spherical form represented in these drawings is almost, if not altogether, confined to anemophilous plants, fertilised by the wind. The cherry is, on the contrary, entomophilous, and its pollen partakes of the general character of this class of plants.



Though somewhat variable in size and form, the grains are, I believe, never spherical, but ellipsoidal, with three longitudinal furrows, as represented in the longitudinal and apical aspects, *a*, *b*, in the accompanying figure. The pollen has, however, well-marked characters of its own, which distinguish it from that of allied plants, the ends often appearing truncated, as represented in *c*, and some or all of the grains more gibbous on one face than another (*d*). Most pollen-grains assume a more spherical form on being moistened with water.

ALFRED W. BENNETT

[1] In Hooker's Primer there is the further complication of the accidental transposition of the figures of the cherry and evening-primrose, the well-known triangular form of the latter being attributed to the former.